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Characteristics of Gothic Cathedrals in France and Their Structural Elements

Terezie Vondráčková[a]*, Vladimír Nývlt[a], František Němec[b]

[a]*Institute of Technology and Business in České Budějovice, Faculty of Technology, Department of Civil Engineering, Okružní 517/10, 370 01 České Budějovice, Czech Republic*

[b] *Institute of Technology and Business in České Budějovice, Faculty of Technology, Department of Informatics and Natural Sciences, Okružní 517/10, 370 01 České Budějovice, Czech Republic*

Abstract

Cathedrals represent some of the finest examples of interconnections architectural, aesthetic, functional, but also the structural design of the building. Their main motivation for the actual construction has been from its beginnings celebration of God, interconnections him with and gathering of believers. The emphasis placed on the aesthetics of the whole building was so crucial. But not always architectural elements were in accordance with the statics of the building. Gothic architecture, based on the earlier Romanesque buildings, points to the development of structural elements. They allow for further development, particularly in terms of building height but also the width of the wall. The aesthetic aspect which has been emphasized, however, was unaffected. Conversely, there has been the emergence of new non-standard architectural solved part of the cathedrals. The dominant design features were the use of external supporting systems, cross vaults and arches as well, which allowed for Gothic buildings to reach huge heights. Due to the fact that the beginnings of Gothic architecture are associated with France, the publication includes analysis of Gothic cathedrals with significant influence of this component, but also historical significance to the future development of this style. It is the cathedral of Notre-Dame in Paris, cathedral in Reims and cathedral in Chartres.

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Keywords: Gothic style, support system, Gothic arch, cathedral

1. Introduction

Cathedral represent historical benefits in terms of structural elements. They were built in the Gothic style from the 12th century, an expanding gradually from France to other parts of Europe. Gothic style follows the Romanesque style from which it took a number of elements, it expanded and developed to perfection in his time. Construction of the cathedral was influenced by the skill of the builders and wealth Country political situation because many damages cathedral suffered during the war or during the French Revolution. Many elements were completed until much later, around the 19th century, such as the famous gargoyles. Although the basic structural elements of each of cathedrals

* Corresponding author. Tel.: +420-387-842-122

E-mail address: vondrackova@mail.vstecb.cz

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and other architectural features are basically not very different, each cathedral has its own specifics. Besides the importance and significance of the various cathedrals there are certain differences, as regards their dimensions and aesthetic elements. Basic characteristics and differences between them are described in the following chapters.

2. Gothic architecture and its significance from the perspective of building constructions

Gothic architecture is an architectural and artistic style emerging in the second half of the 12th century. Gothic architecture is an expression of the desire to get into nearness of God which is demonstrated by long narrow towers. Gothic architecture is the successor of the Romanesque style.

As in any style, Gothic architecture brought a number of innovative solutions in terms of design, architectural or aesthetic and functional. The basic feature of these buildings is becoming particularly slenderness of towers and their verticality.

In terms of functionality and design solutions we distinguish external support systems (Fig. 1). This is an important feature of Gothic. It moved architecture Romanesque buildings with semi-circular arches and thick walls ahead due to the use of pointed arches, and support systems that enable significantly higher construct buildings with distinctive windows. Implementation of external flying buttresses into the perimeter walls were used in the event of Notre-Dame in Paris, and subsequently extended to other Gothic cathedral. They represent the arched support that captures the pressures of the main arches of the nave.

Other distinguishing features is the use of the Gothic arch and ribbed vaults. They represent a combination of constructional and aesthetic significance. The use of vaults allows to build thinner walls and bridging even very wide spaces. In the Gothic period they were implemented cross, a star or a circling arch. Windows and entrance portals with pointed arches are imitating clasped his hands in prayer. Their function is to reduce the pressure from the arch and the possibility to choose the height of the arch.

The supporting pillars are another typical feature. These are arranged at the outer sides of the structure, and they capture the pressure of the side walls. It does not disturb aesthetically interior of the cathedral.

Arcades are one of the elements very typical of the Romanesque buildings, likewise transferred to the Gothic. These can include the one hand, between the design and also the aesthetic elements of the Gothic cathedral. Arcades are characterized by arches, supported by pillars or columns. The warhead is ending columns that fulfils one hand, an important construction component, but also represents part of the decorative. Warhead is adorned with plastic and finely structured. This architecturally rare cathedral serves, among other things also as a model and tool in education of students from the building branches [2] [4] [11] and [19].

Fig. 1 External support system typical of the Gothic cathedral (photo by author)

Among the purely decorative elements of these buildings we include padding of the arches and vaults so called rosettes. These are the windows that are filled tracery. They are glazed with stained glass in different colours with religious motives. Input part of the cathedral represents so called portal. Part of these buildings is very narrow high

tower, known as pinnacle. Pinnacle is a very distinctive dominant, for example, at the cathedral of Notre-Dame in Paris.

Other decorations are gargoyles, which are located at the mouth of the eaves of the cathedral. Arose much later, but they represent a typical part of Gothic cathedrals. Above the windows and above the doors is so called a tympanum. This is a part that is plastically decorated.

Generally, in the Gothic architecture are used load-bearing construction elements also to decorate the space. They are finely detailed and very sophisticatedly decorated.

Functionality is the last aspect, as can be seen part of the Gothic cathedrals. This means that the cathedral is divided in terms of spatial distribution, which allows the use of individual objects necessary for the performance of its functions. Thus we distinguish part of the chapel, part of the chapel choir and chorus, a part of the apse and ships designed for priests. The Cathedral also includes areas intended for the assembly of believers for worship and other opportunities. It is the dominant part of the inner space. This is the nave or nave and aisle. Nave can also interbreed with a transverse nave called transept. This is the nave, clutching a right angle to the nave. It also includes sacristy and other spaces for facilities generally known at the cathedral.

3. Characteristics of gothic cathedrals

3.1. Notre-Dame cathedral in the Chartres

There was a Carolingian Romanesque cathedral in the place before the construction of the cathedral. Since 876 kept the raiment of the Virgin Mary that she was wearing at the birth of Christ. It is the fabric probably originating from Syria. A fire in 1020 destroyed the original cathedral and in its place began to be constructed by the current Notre-Dame [1]. Although the cathedral was hit by fires, raiment of Mary was spared. Cathedral began to be developed under the leadership of Bishop Albert, then under the leadership of Gottfried de Lèves. Part was built in the 12th century. The north tower and west facade were completed in the 13th century.

In the cathedral was used in the completion of a new supporting system, thanks to take the arch part of the load and can be implemented unusually sizable windows filled with stained glass. Further they have been exposed to high arcades and windows of the main nave, which allow penetration of large amounts of light into the interior. The Cathedral has a number of statues, contoured walls and magnificent windows. In the cathedral is preserved sacred light. Stained glass windows illuminate the interior in tones of many colours and depict a variety of scenes. Sculptures depict monarchs and saints, known from the history of life size. Place of worship of the Virgin Mary and comprises a total of 173 portraits on sculptures and stained-glass windows. At the cathedral for the first time reached the height of the nave over 30 m.

3.2. Notre-Dame cathedral in Paris

Construction of the cathedral of Notre-Dame in Paris, began in 1163, before the Reims Cathedral. The Cathedral was founded at the request of the Bishop of Sulla. This is not only historically valuable cathedral in Paris and the masterpiece of French Gothic architecture. This is essentially a place where there were important developments in terms of the development of the French nation. There was crowned Henry VI. in 1422. In 1804 there was a coronation of Napoleon I. Bonaparte [13]. The Great French Revolution, however, resulted in a desecrated of the cathedral. Cathedral of Notre-Dame in Paris was also the subject of study in the publication [8].

Famous gargoyles are part of the 19th century. Typical are the rosette windows. The Cathedral is an entire gallery of the kings of Judah, involving a total of 28 sculptures. Most of them were destroyed during the French Revolution, and therefore it is only a handful of the original. Another group consists of the Virgin Mary statues, together with kings and saints. Rosette windows have a diameter of up to 13 meters. Support system has a span of 15 meters. The highest point is the top of the tower of the cathedral, so called flèche at an altitude of 90 meters. In the top of the south tower is the famous bell called Emanuel. The capacity of the cathedral is up to 9,000 people.

3.3. Cathedral of Notre-Dame in Reims

Cathedral of Notre-Dame in Reims is one of the most important place in France in terms of architecture and of Christianity. Cathedral originated in medieval France. It was a place where French kings were crowned. The

emergence of the church dates back to the 13th century. The Cathedral stands on the site of the former Roman baths, later Romanesque basilica, which was later converted and then burned down in 1210. Construction of the cathedral began after burnout of the original church. Also at that time, were dealt with other issues related to the construction and operation of both the cathedrals and residential buildings, such as wastewater [20].

Cathedral during its existence, has suffered a series of damages. Overall, the cathedral was completed a century later. A fire in 1421 destroyed the roof of the cathedral. In the 15th and 16th century cathedral affected by several fires. Simultaneously in this period were completed towers. From 1779 it is known that there has been damage to the labyrinth of all signs [14]. From the time of the Great French Revolution was damaged bulkhead of choir and windows. Cathedral suffered major damage especially after the 1st World War. After the war started repairing the damaged cathedral as a result of artillery on the one hand, but also fires. Destroying a large number of statues, but today it is one of the most remarkable elements of the cathedral. Statues, whose number exceeds two thousand, also includes 56 figures of the kings of France. Further details also lists publications [3] [12] [15].

The Cathedral represents ultimate medieval work in the Gothic style. It became the model for a series of later buildings across Europe. For the first time they were used window tracery in the tympanum. The decoration of the cathedral is very finely divided and were used by supports. Window height reaches a height of arcades.

4. The specific characteristics of French Gothic cathedrals

Development of Gothic architecture is evident in the comparison these three important Gothic cathedrals (Fig. 2). There are a number of other places, which we here can include, but these three cathedral represent a sort iconseach of which is specific to something else. Gothic cathedral in Chartres was due to the importance of preserving raiment of Mary at this point. This gothic cathedral is the oldest of the three. She is the shortest in length, but with the highest point of the highest church tower with a height of 113 m (Fig. 3). The forehead of the church is oriented to the southwest. There were used typically Gothic elements, characterized by long, slender towers, rosette stained glass, as already mentioned also external supporting system. It is utilized for all three structures. Notre-Dame in Paris is located opposite, ie in the direction of the northwest.

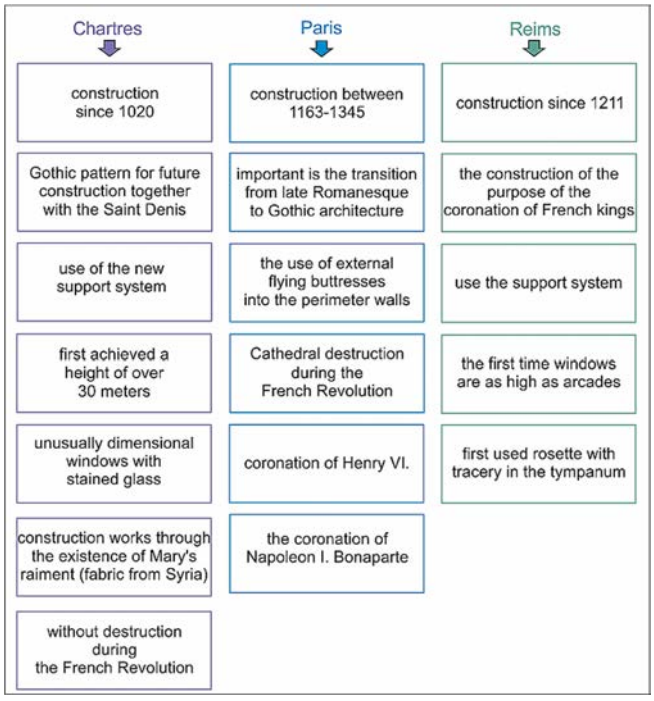

Fig. 2 The significance of the most important Gothic cathedrals in France: Notre-Dame cathedral in Chartres, Notre-Dame cathedral in Paris Notre-Dame in Reims [9] [10] [16] [22].

Unlike the cathedral in Chartres is slightly longer, with a total length of 135 meters. However, its tallest tower so called flèche, which rises to 90 meters does not reach height of the towers of the cathedral in Chartres.

It is evident frontal towers are not completed than originally planned, which if implemented probably reached similar heights as in the cathedral in Chartres. The total width of the Notre Dame Cathedral in Paris, is the smallest of the three cathedrals. The Cathedral has an important position, as it is located in the heart of Paris. Due to the fact cathedral was attended by a number of historically significant events. Portals at main entrances are larger and grander than was the case in Chartres.

Cathedral of Notre-Dame in Reims is oriented to the southwest as well as the Notre-Dame cathedral in Chartres. Regarding the length of the cathedral is the largest compared to the previous two, overall, reaching 149 m. The highest part of the cathedral reaches a height of 81 meters, which is the lowest of the three cathedrals. The total width of the cathedral is slightly lower than at the cathedral in Chartres. The significance of this cathedral is unquestionable, since there took place the coronation of French kings. Although all three of the cathedral are top of the Gothic art, Notre-Dame in Reims is considered the most aesthetic and sophisticated. For the first time they were used rosettes with tracery in the tympanum. It is also apparent that in comparison with two previous cathedrals, windows reach identical heights for the first time with arcades. Architectural and design solutions based on a series of analyses based on mathematical and physical principles [17] [18] and [21].

Regarding the supporting system, which is supplemented from previous cathedrals pinnacles which are very aesthetically. The dominant part of the cathedral is the nave of the cathedral. When comparing the width of the main nave reaches its highest value in Chartres cathedral with 16.4 meters and on the contrary is the smallest cathedral in Reims with 14.65 meters. The highest is the nave of Reims with a value of 38 meters and the smallest in Notre-Dame in Paris, with a value of 35 meters. Construction elements used in Gothic also appear in other papers [5] [6] [7] and [23].

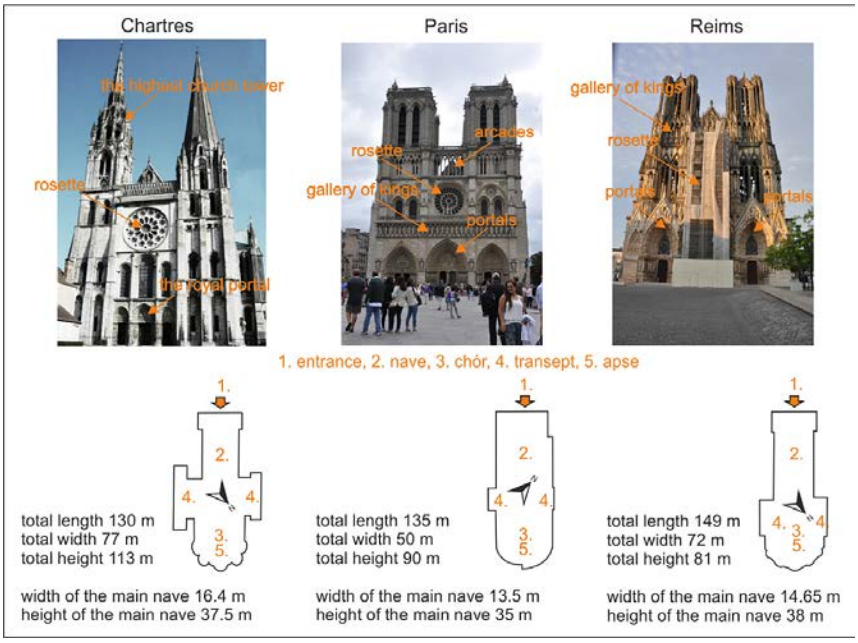

Fig. 3 The cathedral's facade and floor plan: Notre-Dame Cathedral in Chartres, Notre-Dame in Paris, Notre-Dame in Reims [1][13][14] (photo by author).

5. Conclusion

Gothic architecture has brought new structural solutions along with a new style. Its gradual development is evident in comparing the various Gothic cathedrals. The beginnings of the Gothic style belongs to France, therefore, the publication presents one of the greatest French cathedrals associated with the development of Gothic. It is one of the

first Gothic cathedrals, Notre-Dame in Chartres, which became a model for future Gothic buildings, the Notre-Dame Cathedral in Paris and Notre-Dame Cathedral in Reims. For all these buildings were used ribbed vaulting, along with the pointed arch, which together represent an enormous contribution to the stability of the cathedral, needed to ensure the safety of palatial chorus. These are its solution adapted to transmit of horizontal forces. It was also possible to make thinner walls and substantially increase the building without compromising its stability. Typical is pronounced verticality, manifested dramatically in the case of listed buildings.

The highest tower dominates the cathedral in Chartres with a height of 113 meters. The longest cathedral is located in Reims, with a total length of 149 meters. Development of Gothic style is evident on a number of elements. Construction of the cathedral in Reims, which was launched as the last of the three described. In this cathedral was first built windows to the same level as the arcade. Simultaneously there has been used rosettes with tracery to the tympanum. Cathedral of Notre-Dame in Reims also used the outer retaining system that is complemented by pinnacles. It is thus one of the most sophisticated and the most aesthetic of Gothic cathedrals. Cathedral of Notre-Dame in Reims has the highest nave. Notre-Dame Cathedral in Paris, is the smallest of the three cathedrals. Regarding width of the main nave is the largest cathedral in Chartres and the smallest cathedral of Notre-Dame in Paris.

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